CLEAVAGE WITH NUCLEUS INTACT IN SEA URCHIN EGGS

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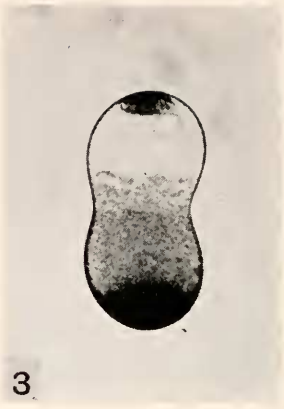
Though, in general, nuclear changes associated with mitosis precede the cleavage of a cell, there are some rare cases in which this is not true. It has been found that in some cases in developing sea urchin eggs, the nucleus may remain as it is in a resting cell, but nevertheless the cell may cleave as it does after mitosis, and produce two quite normal "resting" cells. This has been found to occur in centrifuged eggs which have been stimulated to develop parthenogenetically by treatment with hypertonic sea water (30 grams of NaCl per liter of sea water) for 5 to 15 minutes. After one half to one hour, the egg nucleus remains unchanged but a cleavage plane may come in between the nucleate part of the cell and the non-nucleate part, as it does in such eggs when fertilized (see E. B. Harvey, 1932), resulting in two cells. This has been found to occur in *Sphaerechinus granularis*, *Psammechinus* (*Parechinus*) *microtuberculatus* and more recently in *Arbacia punctulata* and *A. pustulosa* (photographs of living eggs are reproduced in Figs. 1–8). These occasional cases have been observed over a period of twenty years. No further development or change has been observed. It has not been possible to produce such a cleavage lacking nuclear change, with any of many chemical substances tried.

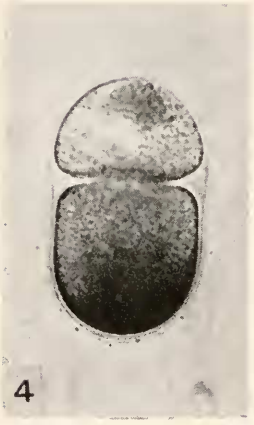
There are in the literature a few references indicating that the nucleus may be removed experimentally. Mazia and Dan (1952) succeeded in removing the mitotic apparatus in an isolated condition from the "fixed" *Strongylocentrotus franciscanus* egg, and later Dan and Nakajima (1956) removed it "fixed" from other sea urchins, *Pseudocentrotus depressus* and *Hemicentrotus pulcherrimus*, with observations also on *Arbacia punctulata*. According to Swann and Mitchison (1953), the eggs of the heart urchin, *Clypeaster japonicus*, may be treated with concentrated colchicine at mid-anaphase, completely abolishing the asters and spindle, and still the egg will divide. There is, of course, the possibility that some part of these structures still remains. To make the experiment more decisive, Hiramoto (1956) sucked out the spindle and asters with a micropipette inserted into the egg, and he found that cleavage still took place.

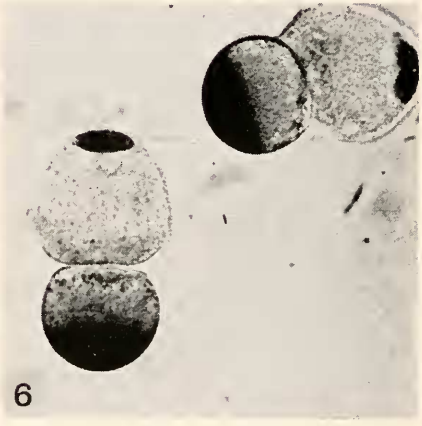
Some years ago (1938), I made a reference in one of my papers to "cleavage planes coming in independently of any nuclear changes" (p. 182) in sea urchin eggs, and Holtfreter called attention to this in his 1948 paper (p. 723). My paper was accompanied by photographs (44 and 57, 58).

Summary

There now seems no doubt that cleavage can take place without any visible change in the nucleus.







FIGURES 1–8. Living eggs.

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FIGURES 1–3. Stratification of unfertilized eggs of *Arbacia punctulata* with centrifugal force.

FIGURES 4–6. Cleavage of centrifuged, parthenogenetic eggs of *Arbacia punctulata*, without the nucleus taking part. Notice the nucleus in Figure 4, slightly enlarged. It becomes sometimes, not always, slightly enlarged.

FIGURE 7. Cleavage of parthenogenetic, centrifuged eggs of *Sphaerechinus granularis*, without the nucleus taking part.

FIGURE 8. Cleavage of parthenogenetic, centrifuged eggs of *Psammechinus (Parechinus) microtuberculatus* without the nucleus taking part.